

CHANGE ISSUE – RTCA/DO-242

MASPS for ADS-B Rev. A

Tracking Information (committee secretary only)	
Change Issue Number	13
Submission Date	1/11/01
Status (open/closed/deferred)	DEFERRED
Last Action Date	10/26/01

Short Title for Change Issue:	Comment from Rick Cassell on 1090 MOPS ballot regarding changing of broadcast rate from 0.5 seconds to 5.0 seconds.
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MASPS Document Reference:		Originator Information:	
Entire document (y/n)		Name	Rick Cassell / Rannoch Corp.
Section number(s)		Phone	
Paragraph number(s)		E-mail	
Table/Figure number(s)		Other	

Proposed Rationale for Consideration (originator should check all that apply):	
<input type="checkbox"/>	Item needed to support of near-term MASPS/MOPS development
X	DO-260/ED-102 1090 MHz Link MOPS Rev A
<input type="checkbox"/>	ASA MASPS
<input type="checkbox"/>	TIS-B MASPS
<input type="checkbox"/>	UAT MOPS
<input type="checkbox"/>	Item needed to support applications that have well defined concept of operation
<input type="checkbox"/>	Has complete application description
<input type="checkbox"/>	Has initial validation via operational test/evaluation
<input type="checkbox"/>	Has supporting analysis, if candidate stressing application
<input type="checkbox"/>	Item needed for harmonization with international requirements
<input type="checkbox"/>	Item identified during recent ADS-B development activities and operational evaluations
<input type="checkbox"/>	MASPS clarifications and correction item
<input type="checkbox"/>	Validation/modification of questioned MASPS requirement item
<input type="checkbox"/>	Military use provision item
<input type="checkbox"/>	New requirement item (must be associated with traffic surveillance to support ASAS)

Nature of Issue:	<input type="checkbox"/> Editorial	<input type="checkbox"/> Clarity	<input type="checkbox"/> Performance	X	Functional
<p>Issue Description: The attached comment states that it is a potential safety issue with respect to runway incursions if the broadcast rate of 0.5 seconds is allowed to switch to 5.0 seconds when own determines itself stationary was presented to the SC-186 plenary in reference to the ballot on the 1090 MHz ADS-B MOPS (DO-260). It was agreed that this issue would be deferred from consideration in DO-260 until it was first considered for inclusion in a future revision of the ADS-B MASPS. Included with the attached comment is the official response from working group 3, which was charted with development of DO-260.</p> <p>Administrative Action: March 5, 2001: Attachment A was added to this Issue Paper. This attachment was submitted by Steve Heppe from ADSI, Inc., and was done so in response to an action item assigned by the ad hoc group charted with revision A of DO-260.</p>					

Originator's proposed resolution:

Proposed resolution is attached with comment from DO-260 ballot.

Working Group 6 Deliberations:

August 30, 2001: At the August WG6 meeting, the original authors of this Issue Paper presented working paper 242A-WP-7-13 supporting the use of the high update rate while aircraft are on the ground. It was stated by WG3 members that DO-260A went to a lower report update rate for stationary aircraft because Wg3 felt the position report itself did not change for stationary aircraft, and therefore did not need to be updated at rates specified in DO-242. [AI 7-9] Carl Evers and Rick Cassell will examine DO-242 and propose specific changes to clarify the MASPS requirements for surface position update rates.

October 26, 2001: A response to this Issue Paper was provided by WG3 for review at the October WG6 meeting. (242A-WP-9-05) It was agreed by WG6 that more analysis is needed from the IP13 authors on the actual requirements of runway incursion algorithms, and by WG3 in their proposal to tighten the criteria for movement determination (which triggers broadcasting at the higher update rate of once per second). Therefore, this Issue Paper is to be deferred from Revision A of the MASPS. However, another result of the discussion was the creation of Issue Paper 50 which requests clarification of Coasting Intervals and Update rate in Table 3-4.

Working Group 3 Deliberations for DO-260A:

July 10, 2002: An analysis of GPS data in regard to Extended Squitter transmission rates on the airport surface was presented to SC-186 WG3 by Bill Harman from Lincoln Laboratory. This analysis is documented in working paper 1090-WP-12-03 and is available on the WG3 web page of the ADS-B web site at <http://adsb.tc.faa.gov/ADS-B/186-subf.htm>. This paper documents the frequency at which a Mode S transponder would be required to switch to the higher broadcast rate for different movement determination criteria. It was agreed at meeting #12 of WG3 (held July 9-11, 2002) to not go forward with any changes in this area for DO-260A because of the following reasons:

1. any such change would require a change to the international standards of Mode S transponders;
2. there was no new requirement included in the recently approved revision A of the ADS-B MASPS;
3. WG3 was not aware of any mature operational concept for a runway incursion system which would require tighter movement determination criteria.

**ADS-B 1090 MHz Rev A Comments Related to MASPS Changes
RTCA SC-186 WG-3/EUROCAE WG-51 SG-1**

#	Comment Author	DO-260 Section	Page	Comment / Rationale	Suggested Resolution
18	Rick Cassell (1)	2.2.3.3.2.3	106	<p>Changing the broadcast rate from a nominal 0.5 seconds to 5.0 seconds when the target is stopped will cause a 5 second delay in alerting on runway incursions. This occurs when an aircraft crosses a hold line from a stop. This is unacceptable from a safety standpoint.</p> <p>Temporary resolution: Added a new Note after 2.2.3.3.2.3.c indicating that further analysis is necessary and it was believed that the rate would be raised to once per second.</p> <p>WG#3 Position: <i>WG#3 feels that changing the 10 ft criteria for detecting movement to 3 ft would be a better solution than changing the low-rate from 5 seconds to 1 second. With most airports that would have a runway incursion system also having LAAS the 3 ft precision should be attainable. This would prevent us from having to change DO-181 also and therefore be a cleaner solution. If this solution is acceptable, there is not an issue here for DO-242A.</i></p>	<p>Several options are acceptable.</p> <ol style="list-style-type: none"> 1. Keep the broadcast rate constant, independent of the vehicle movement. 2. Change the “Low” rate to a nominal 1.0 second broadcast rate. This is an acceptable rate for surface targets. 3. Change the criteria for transitioning between rates from position to velocity. A recommended criteria could be 1.0 m/s. <p>Note that in Table 2-13, the criteria for defining the aircraft as being stopped is <0.125 knots.</p>

Attachment A

COMMENT ON CHANGE ISSUE 13 BROADCAST RATE ON AIRPORT SURFACE

Stephen Heppe/ADSI
March 1, 2001

BACKGROUND:

Rick Cassell submitted a comment on the 1090 MOPS which has been reflected in Change Issue #13 for RTCA/DO-242A. Rick's comment addresses the update rate for ADS-B transmissions on the airport surface. Current 1090 MOPS specify a "low" update rate of once per 5 seconds (average) with the aircraft switching back to a "high" update rate of once per 0.5 seconds if it detects ownship movement (position variation) greater than 10 meters. During the balloting of DO-260, it was questioned if this approach maintained an adequate level of safety (in particular if an aircraft starts to creep forward onto an active runway). Potential resolutions already suggested are to:

- a) increase the "low" update rate to once per second;
- b) reduce the position delta to a smaller value;¹
- c) apply a velocity delta of 1 meter/second.

The issue was deferred from consideration in DO-260 until it was first considered for inclusion in a future revision of the ADS-B MASPS. Hence change issue #13. The discussion below addresses a possible resolution for DO-260 as well as DO-242A.

DISCUSSION:

A low update rate while stopped is consistent with the analysis presented in RTCA/DO-242 paragraph 2.2.2.6.2 and 2.2.2.6.3. A low update rate is suitable as long as ownship stays inside a self-imposed "stop box." **However**, it must avoid any lag or latency when it crosses a threshold. Safety is maintained if ownship can start transmitting at a high rate *immediately* (within 1 second) upon detecting violation of a suitable position or velocity threshold. Since the 1090 MHz avionics can start transmitting immediately when it chooses to do so, there is no need to increase the "low" reporting rate while the aircraft is stopped. A better approach is to allow the low update rate as it stands (or make it lower), and tailor the position and velocity trigger thresholds in order to maintain the needed safety margin considering suitable buffer zones referenced to the airport surface. This maintains an appropriate level of safety while minimizing load on the channel.²

¹ The current comment form quotes WG#3 as suggesting a change from 10 feet to 3 feet. This seems inconsistent with the current MOPS which actually references 10 meters. It is not clear if this is an editorial mistake in transcribing comments from WG#3, or if the participants actually felt that only a 1 meter (3 foot) error was tolerable. This would have to be assessed in light of achievable navigation accuracy. Also, one could imagine providing a somewhat larger "buffer" at the hold line in order to accommodate a slightly greater position uncertainty.

² There can be several hundred aircraft active on the airport surface at any one time, and an airborne user in the terminal area could perceive the squitters from surface aircraft at a large number of local airports.

Attachment A

In principle either a position or velocity threshold, or both, could be used. A position threshold would guard against very slow “creep” due to brakes slipping, whereas a velocity threshold might provide a more rapid trigger in the absence DGPS (velocity variations are generally much smaller than position variations, hence a position threshold suitable for non-DGPS operations might be unacceptably large). The combination of the two might offer a robust set of triggers that would be more reliable under a wider range of conditions, considering the variability of GPS, than either trigger alone.

It is the opinion of this author that the use of both triggers would not add any significant processing load to the avionics; hence it is recommended that the 1090 MHz community consider this approach as an alternative to the use of a single trigger.

This author does not have an opinion on the appropriate threshold settings. This should be addressed by the relevant experts in airport surface movement guidance and control.

It is noted that the 1090 MHz MOPS may need to specify the threshold settings since there is no ability to command a suitable threshold in real time. Other data links, e.g. VDL Mode 4, provide a facility to command a threshold in real time. Hence for these other data links, it is not necessary to specify a threshold in MOPS (or in MASPS).

IMPACT ON DO-242A:

RTCA/DO-242 specifies a 1 second update rate (98% confidence) for ATS provider surveillance and conflict management on the airport surface (Table 2-4a), and 3 seconds (99% confidence) for ADS-B peer-to-peer (Table 3-4). This should be changed to indicate the validity of a lower update rate for stopped vehicles. It is neither necessary nor appropriate to specify the actual reporting rate, or trigger conditions, in the MASPS. The required reporting rate for a stopped vehicle could be technology-specific, as well as possibly a function of location on the airport surface. Likewise, the trigger conditions may be a function of location on the airport surface (if the trigger conditions can be varied, the trigger conditions on the movement area may be more stringent than the trigger conditions on the non-movement area). Reporting rate and trigger conditions could be specified in MOPS (as in the case for 1090 MHz), or specified/commanded in real time (as in the case of VDL Mode 4).

RECOMMENDATION:

It is recommended that the following footnote be appended in Table 2-4a and Table 3-4:

“The received reporting rate for a stopped vehicle may be lower than indicated, subject to the condition that the received reporting rate is increased to the indicated value if predetermined movement criteria are satisfied.”

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